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HARNESS, DICKEY & PIERCE, P.L.C.
P.O. BOX 8910
RESTON, VA 20195

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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

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GROUP 3600

Application Number: 10/608,086
Filing Date: June 30, 2003
Appellant(s): RUSSELL ET AL.

December 13, 2007

Gary D. Yacura
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief of 10/9/07 appealing from the Office action mailed 2/9/07, and the 5/24/06 remand by the Board, directing the examiner:

> *"to determine whether prior art is available that discloses or would have fairly suggested, to one of ordinary skill in the art, performing a computerized optimization process of a nuclear reactor to generate, from received state-point data, one or more independent control variables."*

Background

The Board's Remand of the 11/08/05 Examiner's Answer to appellant's previous 8/10/05 Appeal Brief, essentially directed to the examiner to further search for prior art that teaches the optimization process, in addition to applied art, Musick. The Board did not exclude applied art Musick, per se. In fact, the Board even highlighted a key aspect of Musick's method by underlining the phrase "maximization of plant capacity and availability" (see page 4, line 6). Such highlighting is indicative that Musick has a teaching relevant to the claimed invention but needs to be further complemented by another reference, to show that optimization is achieved when plant capacity and availability is maximized within acceptable fuel design limits.

Note that the claims (e.g., see claim 1) recite:

> *"performing an optimization process on one of a computer and computer network based on the received state-point data to generate one or more optimized independent control variable values." Underlining provided.*

Clearly, the claims do not require performing optimization for all independent control variables. Rather, optimizing at least one independent control variable meets the claim limitation. (Examiner's note: Appellant cites "core flow" (rate of water flow through the core), as one of the independent control variables (see page 2 of the specification). Musick also uses core flow rate as one of the parameters (a.k.a. independent control variable) in maximization of plant capacity and availability (see col. 13, lines 22+ or col. 15, lines 35+). Thus, there is at least one independent control variable that matches Musick and appellant's case).

As discussed below, such other prior art that the Board directed the examiner to search, indeed exists in any one of Dozier et al., or Knollberg, or Pryor, Jr. The combination of Musick with any one of these references reads on appellant's claims.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

A statement identifying the related appeals and interferences that will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

4,080,251	Musick	3-1978
	Dozier, et al. "Winning Strategies for Maintenance Optimization at U.S. NPPs" (Nuclear Plant Journal Editorial Archive)	3-2000
	Knollenberg, "The Energy Supply for the United States & the Role of Nuclear Energy," University of Michigan	4-2000
	Pryor, Jr., "The Economics of Nuclear Energy," Nuclear Plant Journal Editorial Archive	10-1998

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9.1 Claims 31-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Musick (U.S. 4,080,251) in view of any one of Dozier, "Winning Strategies for Maintenance Optimization at U.S. NPPs" (Nuclear Plant Journal Editorial Archive-2000), or Knollenberg, "The Energy Supply for the United States & the Role of Nuclear Energy" (University of Michigan-2000), or Pryor, Jr., "The Economics of Nuclear Energy" (Nuclear Plant Journal Editorial Archive – 1998).

Musick teaches a computerized control method that maximizes plant capacity and availability within acceptable fuel design limits under normal operation and anticipated operational occurrences (see col. 8, lines 23).

Appellant has not defined the term "optimization", and absent such definition, the examiner applies its ordinary meaning, i.e.,

- *"[A]n act, process or methodology of making something (as a design, system, decision) as fully perfect, functional, or effective as possible" (Merriam Webster's Collegiate Dictionary, 10th edition, 1993).*

The above definition of "optimization" does not call for an ABSOLUTE perfection of a process. Rather, it allows for perfection, within reasonable limits, as evidenced by the qualified language, "*as fully perfect, functional or effective* ***as possible***."

Such optimization by reasonable perfection is common in nuclear power plants because of the inherent interdependence of system parameters. Musick himself recognizes this fact by his statement:

> *"Heretofore, the prior art has attempted core protection through means and methods that have sacrificed plant capacity and availability. Various schemes with different degrees of sophistication were implemented, none of which enable the utilization of the plant's full potential. The least sophisticated system consisted of the establishment of a series of independent limits for each of the parameters upon which the design limit in question depended. By doing so, this prior art method could not account for functional interdependence of all of the variables. Thus, the situation could arise in which one parameter deviated from its optimum value, without causing an approach to the design limit since the other parameters on which the design limit depended might have compensated for the one bad parametric value." See col. 4, lines 37+. Underlining provided.*

Clearly, Musick's maximization of plant capacity and availability within design limits optimizes ONLY selected parameters (which includes independent control variables) and NOT all parameters, because changing one parameter inherently causes change in

some other parameters. Note the claims only require at least one independent control variable (not all such variables) to be optimized. Thus, Musick's optimization of selected parameters already far exceeds meeting the claim limitation.

In any case, Dozier teaches several maintenance optimization strategies that have a common goal of increasing reliability and plant availability while reducing costs (see Abstract). He further teaches that optimizing maintenance processes, procedures and schedules reduces refueling outage duration, which inherently extend the interval between outages, and increases plant availability or capacity factors (see page 3, lines 11+). Maintenance processes also ensure that plant systems operate reliably and within design limits. This secondary reference clearly demonstrates that there is a clear nexus between optimization and maximum plant availability.

Knollenberg, in his Paper, "The Energy Supply for the United States & the Role of Nuclear Energy", states:

> "*Shorter refueling and maintenance outages and plant optimization have brought U.S. nuclear power plant capacity factors to their all-time high of 89%. Underlining provided. See page 2 of the Paper.*

Knollenberg's, "all-time high capacity factor" is synonymous to "maximum capacity factor" in Musick.

Pryor, Jr., in his article, "The Economics of Nuclear Energy," remarks:

> *"A number of U.S. nuclear plants are recording capacity factors in excess of 90 percent.... These improved capacity factors have been driven primarily by reductions in outage durations. ... Although the top ten plants are achieving excellent forced outages approaching 0.1 percent, the industry, in general, is well off the pace at slightly greater than 0.3 percent. The industry needs to continue to focus on this area of improvement to achieve 0.1 percent forced outage rates. This can be done with greater outage and maintenance optimization. Underlining provided. See page 2.*

Any one of these references clearly shows that one cannot achieve maximum plant capacity without performing optimization, and such optimization inherently involves optimizing <u>at least one independent control variable of the reactor system.</u>

The examiner has previously shown that Musick's computerized control process generates one or more independent control variables from received state-point data (see Background section above).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of the invention to have considered Musick's control process as an optimization that <u>maximizes plant capacity and availability</u> within acceptable fuel design, based on the teaching of any one of Dozier, Knollenberg, or Pryor, Jr. Such maximization inherently includes optimization of <u>at least one independent control variable of the reactor.</u>

9.2 Claims 40 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Musick with any one, as applied to claims 31-39 above, and further in view of Takeuchi et al.

The combination of Musick with any one of Dozier, or Knollenberg, or Pryor, Jr, teaches using actual plant data to relate independent variables (e.g., coolant mass flow rate) to the dependent variables (e.g., core power, Q). See, for example, the DNBR (Departure from Nucleate Boiling Ratio) equation at col. 3, lines 35 or Col. 15, line 34, in Musick.

This DNBR is a transfer function because it represents a functional relationship between independent control variables and dependent variables.

Another example of such transfer function is the Local Power Density (see Fig. 9 and col. 37, lines 9+).

Musick teaches the algorithms for determining these transfer functions (e.g., see col. 39, lines 29+ for the DNBR and co. 38, lines 53+ for the Local Power Density.

These algorithms are executed by an in-system Core Protection Calculator (CPC) 58 or Core operating Limit Supervisory System (COLSS) 60 (see Fig. 1 and col. 11, lines 40+). The performance of the algorithm instructions to calculate the transfer functions relating to the operation of the reactor reads on appellant's claim language, "simulating reactor operation."

If appellant is of an opinion that such calculation by the in-system CPC or COLSS is not his interpretation of "simulation", then Takeuchi et al. teach the use of a separate simulator, i.e., a computer for evaluating plant conditions (see Abstract).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method, as disclosed by the combination of Musick with any one of Dozier or Knollenberg, or Pryor, Jr., by the teaching of Takeuchi et al., to use a separate simulator to calculate the transfer function, to gain the advantages thereof (i.e., allow separation of functions of simulation and control of the reactor), because such modification is no more than the use of well-known expedients within the art, and the substitution of one expedient for plant analysis by another well-known expedient.

As to the claim limitation, "determining a set of independent control variable values <u>for possible use</u> in operating the operating nuclear reactor using the transfer functions," the term, "possible use" means that the use of the independent variables in reactor operation, following their determination, is <u>**OPTIONAL**</u>, i.e. not required. Thus, even if appellant would disagree that the independent variables calculated in the modified Musick is not used for operation (the latter not being the case), this applied art still reads on the OPTIONAL claim limitation.

10) Response to Argument

As to claims 31-39, Appellant argues that "Musick: fails to teach 1) "an optimization process," 2) "based on received state-point data," to 3) 'generate one or more independent control values." The examiner disagrees.

As to argument 1), Musick's process "maximizes plant capacity and availability without violating the specified acceptable design limits as a result of normal operation and anticipated operational occurrences." See col. 8, lines 25+.

"Optimization" does not call for an ABSOLUTE perfection but allows for perfection, <u>within reasonable limits.</u>

Musick admits that his maximization of plant capacity and availability within design limits optimizes ONLY selected parameters (which includes independent control variables) and NOT all parameters, because changing one parameter inherently causes change in some other parameters.

The claims only require at least one independent control variable (not all such variables) to be optimized. Thus, Musick's optimization of selected parameters already far exceeds meeting the claim limitation.

The examiner has shown that maximization of plant capacity and availability INHERENTLY includes optimization of at least one independent control variable, as confirmed by the teaching in any one of Dozier, Knollenberg, or Pryor, Jr.

As to argument 2) Musick uses state-point data, i.e., current data, as evidenced by Fig. 9 showing signals from sensors of primary pressure, control element assembly (CEA) positions, ex-core power, reactor coolant pump speed, hot leg temperature and cold leg temperature. These sensors provide current values of these independent control variables (i.e., primary pressure, etc.) and deliver them to either the core protection calculator 58 or COLSS 60, as part of the optimization process (see col. 11, lines 40+).

As to argument 3), Musick states:

> *"Some of the variously generated signals representing the reactor parameters described above are also delivered to a calculation means 60 called the Core Operating Limit Supervisory System (COLSS). It is the function of COLSS 60 to make a very accurate calculation of a DNBR operating limit which contains sufficient margin to allow the core protection calculator to sense, calculate, predict and shut the reactor down in a timely fashion that avoids the violation of any fuel design limits. The operating limit thus generated may be utilized in either of two fashions in order* <u>*to control the operation of the reactor*</u>*. The first is merely to register the limit on a visual indicator 170 which would allow the reactor operator to compare the actual reactor operating condition to the COLSS limit. With this knowledge available to the operator, he will be able to operate the reactor in such a way that a sufficient margin is continuously maintained* <u>*while at the same time maximizing the capability and availability of the reactor.*</u> *The second method would be to automatically restrict the plant power to be within the COLSS limit thereby insuring that the necessary margin is maintained." See col. 12, lines 6+.*

The optimization process in Musick inherently generates values of at least one independent control variable (e.g., reactor coolant pump speed or primary pressure) at

which this variable must be maintained during plant operation, to ensure that sufficient safety margin is maintained while optimizing reactor operation.

As to claims 40-41, appellant argues that the neither one of Musick, Dozier, Knollenberg, Takeuchi, alone or in combination teach or suggest: a) "generating transfer functions based on sets of independent control variable values ..."; and b) "determining a set of independent control variable values for possible use in operating the operating nuclear reactor using transfer functions." The examiner disagrees.

The examiner has shown in section 9 above that the applied art meets the limitations of generating the transfer functions and determining a set of independent control variables.

The examiner has further shown in section 9 that not withstanding the fact that the claims do not require the use of these independent control variables in operating the nuclear reactor, the applied art actually goes above and beyond what is required because these variables are indeed used in the applied art for operating the reactor.

(11) Related Proceeding(s) Appendix

Since appellant stated in the "Related Appeals and Interferences" section that there "are no known appeals or interferences that will affect , be directly affected by, or have a bearing on the Board's decision in this Appeal," it is assumed that appellant meant to include the appendix with a statement of "None", as per MPEP 1205.03.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Ricardo J. Palabrica, PhD
Primary Examiner

Conferees:

M. Petravick

J. Keith

HARNESS, DICKEY, & PIERCE, P.L.C.
P.O. BOX 8910
RESTON, VA 20195